DESIGN, PLANNING, AND EVALUATION OF UPGRADED CATTLE HANDLING FACILITY

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ABSTRACT

This senior project discusses the design, planning, and evaluation of a livestock handling facility for Tulloch Ranches. The facility will be an upgrade to the facility currently used at the ranch in Pine Valley, California.

The design parameters for the facility were narrowed down to the following:

1. Must reduce stress to animals during handling.
2. Must be cost effective to save labor and maintenance.
3. Must show improvement from the current set- up.

The above parameters combine to form a system that enables the handlers of Tulloch Ranches to manage and work cattle in a more calm and humane way while allowing cattle to have a lower stress level while performing at optimum capacity.

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INTRODUCTION

Having a successful livestock operation lies in the ability to properly handle animals to reach maximum efficiencies and performances. Livestock handling facilities are a vital part of a successful ranching operation. They are essential in properly managing and restraining livestock and also moving them for various reasons. Humane livestock handling has become more and more of an issue over time. Cattle handling facilities have been under further scrutiny because of their increased size as well as the increased number of cattle in each operation. The industry has grown over the years to meet the needs of the population so the facilities must grow as well. In the state of California beef production contributes billions of dollars towards the state's economy. Beef is in the top ten commodities of California and it is necessary to have facilities in which to house and work the animal.

In order to meet the demands of the beef industry, owners are forced to modify facilities to better suit their specific operations for the enhancement of the cattle and handlers as well as meet the approval of the public opinion. The current cattle handling facility at Tulloch Ranches is not adequate for cattle or people. Cattle need to feel comfortable in the corrals and pens and that is not the case for this ranch. If cattle are under a lot of stress they will not perform as well in breeding programs, shows, or at the slaughterhouse.

The goals of this project include:

1. Evaluating the current handling facility for approvals and improvements that can be made.
2. Investigating the possible solutions to improve the functionality of the facility to make it better suited for cattle. The evaluation will look at the entire operation which includes gates, fences, pens, water troughs, calving pens, transporting pens, lead up chutes, calf tables, squeeze chutes, feeders, and how the current system can be modified to better accommodate cattle more humanely.
3. Design an upgraded facility that will handle cattle in a more humane and calm fashion while allowing handlers to operate more efficiently on a day to day basis.

The completion of this project will not only benefit the ranch but also the cattle. Under less stress, the cattle will be more apt to cooperate with the cattle ranchers. This will enable the owners of the ranch to operate more efficiently and effectively with their day to day tasks.

LITERATURE REVIEW

The Tulloch Family Partnership is a commercial cow/ calf operation located east of San Diego, California. The ranch currently owns and maintains 500 head of cattle with breeds ranging from Hereford, Angus, Simmental, and multiple combinations of the three. The ranch owns approximately 10,000 acres of land spread out between five different locations throughout the county. Each location has at least one handling facility. The handling facility that is being upgraded is located on Buckman Springs Road in Pine Valley, California. This facility handles the majority of the ranch's cattle as well as cattle that are being shipped from other surrounding ranches to auction yards in Chino, California as well as Famosa, California. By upgrading this facility, cattle will be handled more calmly which will make for better production and performance in the long run.

Cattle Behavior

The performance, carcass value, and meat quality of beef cattle can be optimized if cattle producers apply their knowledge of bovine social behavior (Epps, 2006). Animal behavior is defined as the expression of an effort to adapt or adjust to different internal and external conditions (Animal Behavior, 2009). This is the study of everything that animals do regardless of what they are. Animal behavior also deals with the connection between animals and their physical environment. Cattle have long memories, as do most humans, which can make it difficult to handle them if they have been exposed to previous

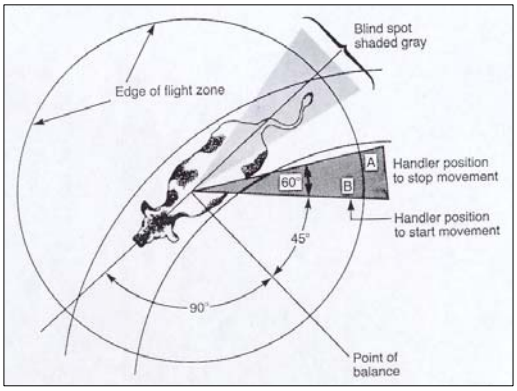

Figure 1 - Beef Cattle Flight Zone.

trauma.

There is an old saying, "You can tell what kind of a stockman a person is by looking at the behavior of his cattle." As shown in Figure 1, cattle have wide angle vision. They can see behind them without turning their heads however there is a small blind spot behind their rear (Grandin, 2000). Cattle tend to move together to help protect each other from predators. The flight zone is the safety zone for cattle. When the flight zone is penetrated, the animal will move and when the flight zone is retreated from, the animal will stop moving. The size of the flight zone is determined by many factors, such as wildness or tameness, and the angle of the handler's approach (Grandin, 2000). When working cattle in smaller spaces such as holding or crowding pens, extra care must be taken to avoid

deep penetration of flight zones. If care isn't taken cattle may panic, jump fences, or even turn back on the handler.

In Bulletin #906 of The Ohio State University Agriculture department, an evaluation showed different classifications of cattle behavior to be broken down into 6 categories. Category #1 is docile where cattle are gentle, handle quietly, and have slightly elevated respiration. Category #2 is restless. This is where cattle are more active with elevated respirations but settle down after rejoining the group. Category #3 is nervous. In category #3 cattle are in constant movement with occasional bumps into fences and gates. They always seem to watch handlers when they are approaching the group. Category #4 is the flighty stage. Cattle are agitated by handling and avoid handlers. They tend to bump into fences and gates and always watch the handlers as they approach the group. Category #5 is more serious. In this category cattle will bump into fences and gates and may be willing to challenge handlers and attempt to jump fences or gates. If cattle are in category #6 which is considered very aggressive either the cattle need to be culled or the handlers need to re-evaluate their management practices. This category is where cattle are very aggressive towards handlers. They also jump and bellow while in the chute. The very aggressive cattle will exit chutes frantically and may still exhibit aggressive behavior.

Mark Deesing discussed his theories about the relationship between position of the round spiral hair whorl on a horse's forehead and its temperament (Grandin, 2008). Mr. Deesing noted that horses with a spiral hair whorl above the eyes were more difficult to handle. Cattle have that same hair whorl so Temple Grandin tested his theory on a herd of cattle that were going through a squeeze chute for vaccinations. More than 1,000 head of cattle were observed and they clearly proved that animals that struggled during restraint were significantly more likely to have a hair whorl above the eyes (Grandin, 2008). The figure below illustrates how to read a hair whorl. The image on the top, left of figure 2 demonstrates how to locate the hair whorl in regards to the eyes and nose of the subject. The image on the top, right of Figure 2 shows that cattle having a hair whorl below the eyes are calmer and easier to handle. The bottom, left image tells handlers that cattle with a spiral hair whorl above the eyes are more likely to be flighty and finally the bottom, right image demonstrates that cattle with an abnormal and deformed line instead of a round spiral are more likely to have sperm defects.

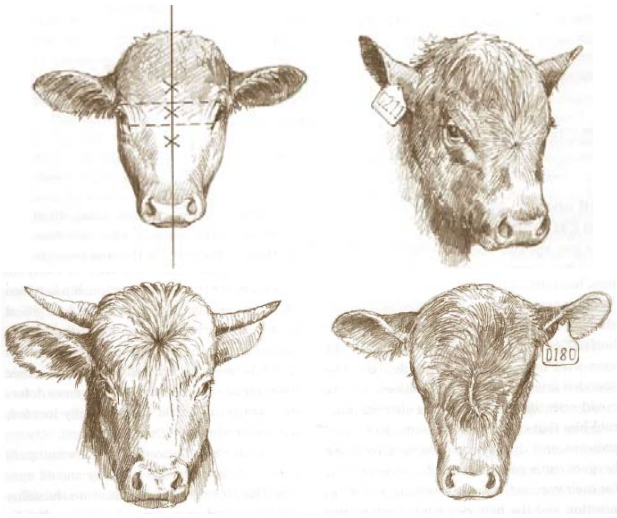

Figure 2 - Examples of hair whorls on cattle.

Facility Guidelines

All handling facilities should have guidelines when being built. These guidelines should be followed to ensure safety of cattle as well as handlers. The heart of a corral is the working chute and crowding pens. Desirable characteristics for a working chute include: curved, totally enclosed sides, sloping sides, overhead restrainers, minimum of 20 feet long, and rough concrete floor. Corrals constructed with round holding pens, diagonal sorting pens, and curved drive lanes will enable you to handle cattle more efficiently because there is a minimum of square corners for the cattle to bunch up (Grandin, 2000). There are different guidelines to follow depending on what sizes of cattle are going to be

Facility component	Up to 600 lbs	600 to 1,200 lbs	Over 1,200 lbs
Holding pen			
Space per head (ft^2)	14	17	20
Pen fence			
Height (in)	60	60	60
Post spacing (ft)	8	8	8
Post depth in ground (in)	30	30	30
Crowding pen[1]			
Space per head (ft^2)	6	10	12
Post spacing (ft)	4 - 6	4 - 6	4 - 6
Solid wall height (in)	45	50	50 - 60
Working chute[2]			
Straight side (in)	18	22	28
Fully tapered—width at 32-in height (in)	18	22	28
Fully tapered—width at bottom (in)	15	16	18
Minimum length (ft)	20	20	20
Maximum curve angle (degrees)	15	15	15
Length for 16-foot outside radius (ft)	45	45	45
Solid wall height (in)	45	50	50 - 60
Overall height—top rail (in)	55	60	60 - 72
Chute fence			
Post spacing (ft)	6	6	6
Post depth in ground (in)	36	36	36
Holding chute/squeeze			
Height (in)	45	50	50
Width			
Straight sides (in)	18	22	28
V-shaped sides, width at bottom (in)	6 - 8	8 - 12	14 - 16
Length—with headgate (ft)	5	5 - 8	5 - 8
Loading chute			
Width (in)	26	26	26 - 30
Minimum length (ft)	12	12	12
Maximum rise (in/ft)	3.5	3.5	3.5
Radius of a curved chute (ft)	12 - 17	12 - 17	12 - 17
Spacing of 1x2-in hardwood cleats (in)	8	8	8

[1] Crowding pen: it must be of either circular shape (1/4 or 1/2 circle) or funnel shape.
[2] Working chute: it should be curved or offset (offset angle at 30° maximum).

Table 1 - Specifications for cattle handling facilities.

handled. Bulls need more room than small feeder calves do so a facility should be designed to accommodate size. A general guideline to follow for short-term holding pens is that cow and calf pairs require 35 to 45 square feet depending on the calf size, cows with calves over 350 pounds require more than 35 square feet per pair, and adult cows and market weight fed cattle require 20 square feet (Grandin, 2008). Facilities that are properly constructed and maintained in good working order will enhance the producer's time management and safety (Field, 2003). The above table was generated by the College

of Agriculture at the University of Kentucky and breaks down the different spaces needed for different sizes of cattle and various components of a handling facility.

Behavior has to be taken into account in designing the proper facility. Cattle are easily disturbed by loud or unusual noises, such as those made by motors, pumps, and compressed air (Field, 2003). A major problem that handlers face when designing facilities is the presence of shadows. Cattle are fearful of shadows so they need to be prevented. Something else to keep in mind is the placement of loading chutes in relation to the sunlight. Loading chutes and squeeze chutes should face north and south because cattle do not move easily into direct sunlight (Field, 2003). Curved chutes are preferred over straight chutes because cattle are unable to see what is around the curve until they are almost there. A curved chute also utilizes the natural tendency that cattle have to circle around the handler. The catwalk should be placed on the inside of the curved chute so that the handler is positioned at the best angle for working.

Design Layouts

As the world population of farm animals increases to cater for the increased human population, their effect of interaction with the environment becomes of major significance (Phillips, 2001). This is why design layouts are so important. Every facility is built with certain guidelines and specifications based on the purpose of the facility. Designs can be as simple as lines on a napkin all the way up to professional drawings in AutoCAD. In *Beef Cattle Behavior and Facilities Design* there are a number of designs that have been created. The seven that were chosen that best suit the operation at Tulloch Ranches can be found in Appendix B. A variety of elements from each design may be used in the final layout of the new facility.

The first design that was selected is very basic. It was chosen to show the standard type of facility that can be built. The basic layout includes diagonal pens, a curved lane, round forcing pen, a loading ramp, curved race chute, and a squeeze chute. These elements work well for small operations. The second design, “Basic Cattle Layout-2”, was chosen due to the fact that it has a section for a single file loading ramp for large trucks which Tulloch Ranches has. The third design, “Basic Forcing Pen Plan”, has not only a ramp for large trucks but incorporates a loading lane for stock trailers. This is extremely useful because the cattle aren’t always hauled away in large quantities. The fourth layout, “Basic Forcing Pen Plan”, integrates not only a squeeze chute but a calf table as well. This makes it so that the calf table can be more permanent and not have to be taken out when calf working is finished.

The next layout, “Corral for 150 Cow and Calf Pairs”, brings a lot of the elements from the previous layouts together and also includes a livestock scale. This design has both types of chutes for trailers, as well as calf and normal squeeze chutes. The scale would have to increase because Tulloch Ranches operates more than 150 cow and calf pairs. Included is a layout specifically for ranch sorting. This involves many gates and divided pens. Ranch sorting layouts are essential when weaning and preparing for transport. The final layout, Basic ranch and Feedlot Shipping and Sorting Pens Layout, was included to

emphasize the diagonal pens. They are useful when the ranch ships cattle. When shipping cattle it is vital that if more than one ranch is involved that their cattle be kept separate. This makes management of paperwork easier at the auction yard or feedlot. All designs discussed above will be considered when designing the final facility.

Current Cattle Handling Facilities

With all of the information available on different handling facilities, interviews were conducted to talk to individuals in the industry who are using their facilities today. The first subject was the Bear Valley Ranch in Parkfield, California. The ranch is owned by Kevin and June Kester along with their three children. The ranch consists of 22,000 acres with 200-250 commercial cows. Based on the vegetation activity for the year, the ranch also runs between 2,000- 3,000 yearling calves. The facility at their ranch is thirteen years old and was built in three phases over the course of 1994, 1995, and 1996. The facility is used throughout the year for various tasks. Yearling calves are shipped and received twice a year, the branding and weaning is done once a year, as well as brucellosis vaccination of heifers. The facility is also used when cattle need medical attention.

The facility was designed using the idea of a facility built by Kevin Kester's father during World War II. He said that the materials used in the previous facility were wearing out and the facility needed a remodel. The facility is similar to the one built in the 1940's. The scales and alleyway are essentially the same. The holding pens are similar to the previous facility. The lead up chute design was changed due to the amount of cattle being run through the facility. The facility construction was handled by a professional welder who specialized in corrals and an expert was brought in to build the scale and lead-up chute. Something that Mr. Kester kept in mind when re-designing the facility was to minimize bruising on the cattle. The yearlings that are kept at the ranch have a destination of the feed lots and minimal bruising is optimal in achieving high quality grades. Since being re-built, the ranch has seen an increase in quality and behavior of all cattle run through the facility.

Mr. Kester said that he is satisfied overall with the facility. He is pleased with how the scale, alley ways, and lead-up chute turned out. When asked about what could be changed he mentioned that there are not enough gates throughout the corrals. With a limited number of gates it is difficult to sort and send cattle in different ways. Some gates have been added since the completion of the project in 1996 but more would benefit the layout and overall smoothness of the operation. In this case satisfaction from both the handlers and the cattle are accomplished. Not only are the handlers happy with the flow of the system but the cattle are producing better and the meat is grading higher.

At Cal Poly, there are different locations with diverse configurations. At the Beef Center located near Cuesta College, the facility is set up as shown in figure 3. Mr. Mike Hall, the

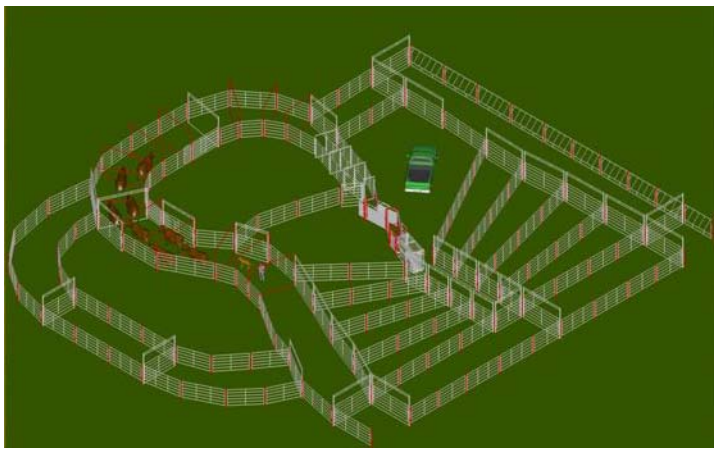

Figure 3- Layout of Cal Poly Beef Center.

Senior Beef Specialist at Cal Poly, San Luis Obispo said that he likes the "bud box" idea that is in place at the Serrano Ranch location at Cal Poly. The idea is that when cattle are run down the alley they enter the bud box as show below in red. The box is designed for 5- 6 head of cattle and the handler is in the box as well. The idea behind this system is that as the handler moves counter- clockwise in the box (represented by the circle), the

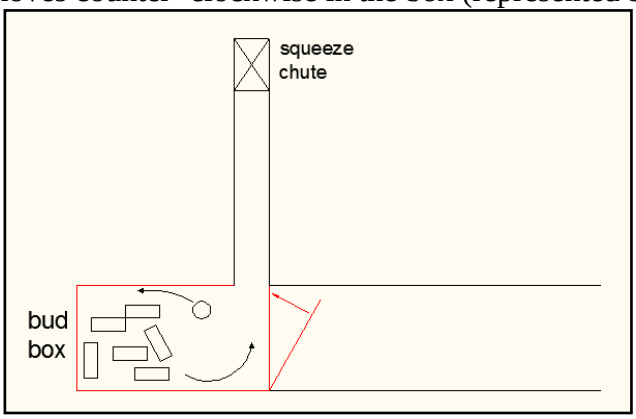

Figure 4 - "Bud box" concept at Serrano Ranch.

cattle (represented by the rectangles) will travel behind the handler in a natural way and enter the lead up chute. Mr. Hall said that some design specialists don't approve of this set up because it forces the handler to be in the box with the cattle causing more stress. He explained that every system and facility is going to be different based on the type of operation. He also emphasized that there are masses of designs and opinions in industry and that narrowing down ideas is important to suit your specific needs.

PROCEDURE AND METHODS

Evaluation of Existing Facility

The existing facility is located on Buckman Springs Road in Pine Valley, California, just nine miles from the Mexico- California border. The ranch location is bound by many mountains, creeks, and a major highway known as Interstate 8. In order to closely approximate the size of the facility while using the resources that were available, a steel tape measure and hand drawings were used. The use of a quality digital camera was also vital for reference photos. First the perimeter of the facility was walked to get an overall idea of what was being evaluated. Once that was complete, taking measurements began. From the personal contact of Mr. Tulloch, it was known that measurements needed to start being taken based off of the main hay barn because that location is square and the panels of the horse barn are straight. Rough angles were calculated and Pythagorean's Theorem was manipulated to achieve fence line lengths and hidden reference lines. The initial measurements took approximately 3 hours to attain since modern technology like Global Positioning Systems were not readily available. There was a better understanding

Figure 5 - Google Earth image of facility location.

of the current system because walking the entire facility and measuring extensively allowed for a more in depth evaluation of what the cattle go through when moving through the corrals.

Knowing a rough estimate of the lengths and angles of the facility was necessary in this project because of the nature of the update. There were many constraints facing the evaluation and update of the facility which made it difficult to design. Figure 5 above shows a Google Earth image of the facility. The new facility will be in the same location and will incorporate existing parts while updating and changing others.

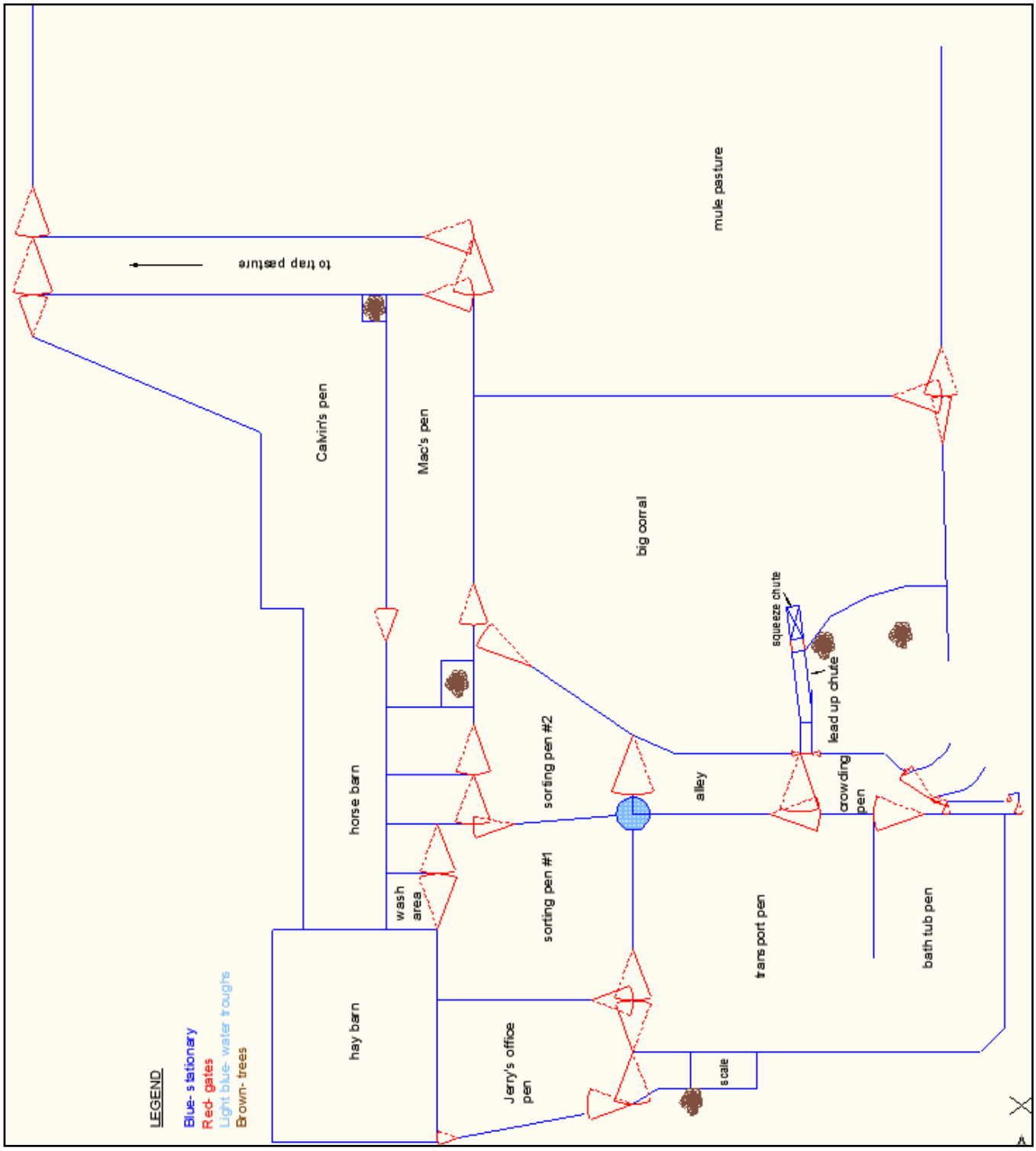

Figure 6 - Current facility layout.

The current facility is shown above in Figure 6. All main components are titled with moving parts such as gates being shown in red. Stationary parts like fences, water troughs, and the chutes are in blue. A larger view of the current facility can be seen in Appendix C.

Facility Guidelines

The orientation of the facility needed to be similar to that of the current one, since the size of the operation hasn't changed nor have the principles of the operation. However within the new design it was hoped that all flaws and impairments of the current facility could be reduced or even eliminated. Listed below are a few items of which the owners of Tulloch Ranches hope to correct in the new facility:

- Limited holding pen space for cattle to be shipped
- Fences that have been destroyed due to falling trees
- Limited feed bunk space
- No facility for calving pen
- Congestion in crowding pen to lead-up chute
- Calf table incorporation

Proposed layout drawings were supplied by Mr. Benjamin Tulloch in hopes that they would be manipulated to incorporate all of the above concerns. These drawings are included in Appendix D.

Design of Tulloch Ranches Layout

Big Corral. The upgrade of the facility began with the big corral. By evaluating and changing this first, the entire system could be expanded and adapted based on the placement of the new fence lines. It was decided to move the east fence out to run in-line with the east fence of the alley to the trap pasture. With the movement of that fence it allows more room in the big corral for larger numbers of animals to be held. Along with that fence being moved back it was essential to add in a gate in that corner. The fence running east and west along the south side of the facility will be extended due to a soft spot in the ground that is not acceptable to put a fence in. That entire fence must be replaced due to a tree that fell during a high wind storm.

Mule Pasture. Currently the Mule Pasture is used to house the cowboy's mules. The owner feels that the pasture is not being used to its full potential. To make this pasture usable for more than just mules, the pasture was divided in half to make two smaller paddocks. Feed bunkers were placed in both paddocks as well as the big corral with a ten foot opening and appropriate gates for the feed trucks and tractors to get through all pens. The feed bunkers are made out of concrete and are 68 feet in length providing eating space for approximately 34 head of cattle. There is already sufficient water supply in the two paddocks so no modification is needed to the water troughs.

Transport Pens. A huge part of the operation at Tulloch Ranches is the ability to keep cattle overnight for transport to live cattle auctions mostly located in Famosa, California. With that and the high risk of diseases and traceability, it is essential that cattle from different ranches need to remain separate overnight before being loaded onto trucks. The current system only had room to keep cattle in three different pens. The current configuration had been destroyed by bulls and cows, therefore the existing fences were in need of repair or an upgrade. The new design allows for three different transport pens, the use of the mule pasture as well as the turn- out pen, the new big corral, and the sorting pens. By doing this the cattle can stay separate for people to deliver cattle as well as make it easier the day of shipping to keep each ranch's cattle separate from the other. When other ranches bring their cattle to Tulloch Ranches for shipping they also bring their own hay for the cattle. Currently there is no storage for other ranches that are shipping cattle. The new design includes an overhang so hay can be out of the weather and near the cattle that are being shipped. In the current configuration there is one water trough that provides water to four different pens which include the transport pen, alley, and both sorting pens. With the new upgrade there needs to be more water available so there will have to be an additional water trough that will be six feet in diameter to provide water to the middle transport pen and bath tub pen. Gates were added to the transport pens so a tractor can get through and clean them out.

Processing Area. The heart of all working facilities is the processing area. Because it can severely limit the speed and efficiency of working cattle, the entire facility design was based off of the processing area. The alley was already in place so no modifications were made here. The concept of the crowding pen is a modified "bud- box" which is based off of an idea that Cal Poly's Beef Unit already has in place at their Serrano Ranch location. This is shown in Figure 4 of the Literature Review. Some constraints in re-designing the crowding pen were that some fences were already permanent and could not be modified as advised by Mr. Tulloch. As seen in most cattle handling layouts shown in Appendix D, most layouts include a tub or sweeping type crowding pen. From past years experience Mr. Tulloch noted that most of them don't seem to work for his operation. This made a challenge when trying to find something that would work and please him. That is when the idea of a modified "bud- box" came into play.

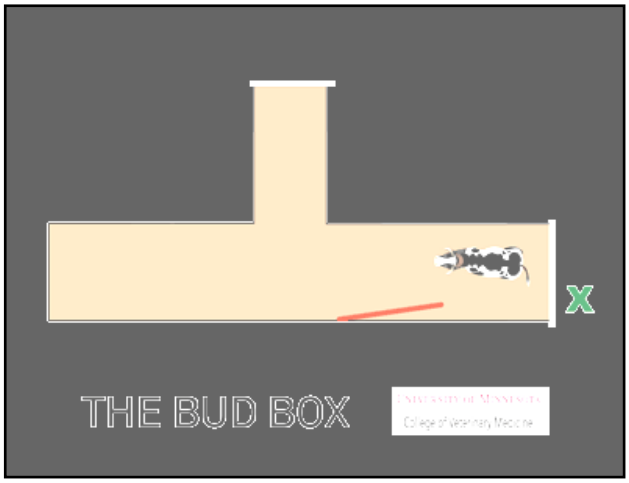

Figure 7 – "Bud Box" Concept.

In the crowding pen two new gates were added. One gate is fourteen feet long and one gate is twelve feet long. The twelve foot gate is attached to the south end of the lead-up chute while the fourteen foot gate is further south only twelve feet from the end of the corral. The spot where the ends of the two gates meet creates a funnel for cattle to go through. This allows for a five foot opening for cattle and handlers to move through with the idea of it funneling down to go into the lead-up chute. This design prevents the cattle from feeling trapped while keeping them moving and keep handlers safe. When the gates are not needed for access to the lead-up chute, they will lay along the east fence of the crowding pen so cattle can either be held in the full crowding pen or be moved onto trailers.

The path to the squeeze chute is in a good position. Currently there is a panel blocking an opening to bring in a portable calf table. A problem with this is that some of the larger cattle that need to move down the lead up to the squeeze chute tend to try and jump over that panel. Because that panel is not permanent, larger cattle can make it through. Powder River Livestock Handling Equipment makes a “diversion alley” seen in Figure 8. While trying to save Mr. Tulloch money, this piece of equipment does not need to be purchased

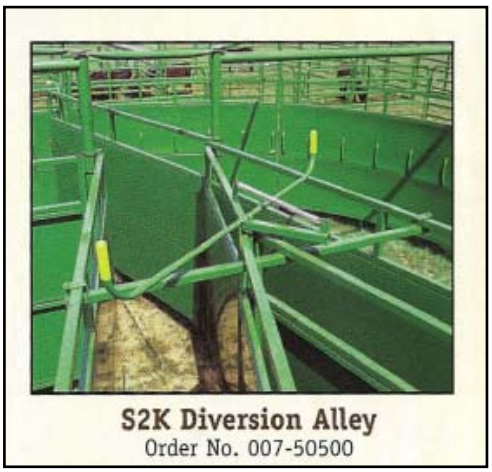

Figure 8 - Powder River Diversion Alley.

but will be fabricated on-site at the ranch. Two different alleys will be created with an additional solid six-foot diversion gate to allow cattle to either move through the lead up chute to the squeeze chute or have calves divert to the right through a different lead up chute into the calf table. Currently the calf table is portable but Mr. Tulloch said that if he could find another one then it would stay in that location.

The final addition to the processing area is the addition of a calving pen with a small turnout pen for not only the calves coming out of the calf table but also for cows that have just had calves pulled and require close attention. The calving pen has already been purchased from Powder River Company but has not been installed. By having a calving pen, the cows can be put under less stress than trying to run them though the lead-up into the squeeze chute where they will be more likely to get stuck or have troubles. The calving pen has a head gate and a small area for a handler to get in to pull a calf. Having a small turnout pen would allow for close monitoring and also have a gate to let the cattle

back into the big corral. There will be a twelve-foot gate installed to lead into the calving pen but also a six-foot gate located along the west of the crowding pen to close off the crowding pen making them separate.

RESULTS

Layout

After combining all the requests of Mr. Tulloch and incorporating the design constraints the following was produced. The design provides three transport pens, two sorting pens, the processing area, one large corral, and two turnout pens for a variety of functions. In Appendix C the full design layout can be seen with all pens and chutes properly labeled as well as a drawing showing all dimensions.

Big Corral and Mule Pasture

The big corral was designed keeping in mind the idea of a multi-purpose corral. Not only can cattle be run through the processing area into the corral but there are now many feed bunks for cattle that are being shipped. By moving the west fence out fourteen feet, more cattle can be held in the corral. There was no place for feed bunkers so those were placed along the fence that runs north and south. Along with the expansion of the big corral the mule pasture was modified to be two different paddocks also including feed bunks. As

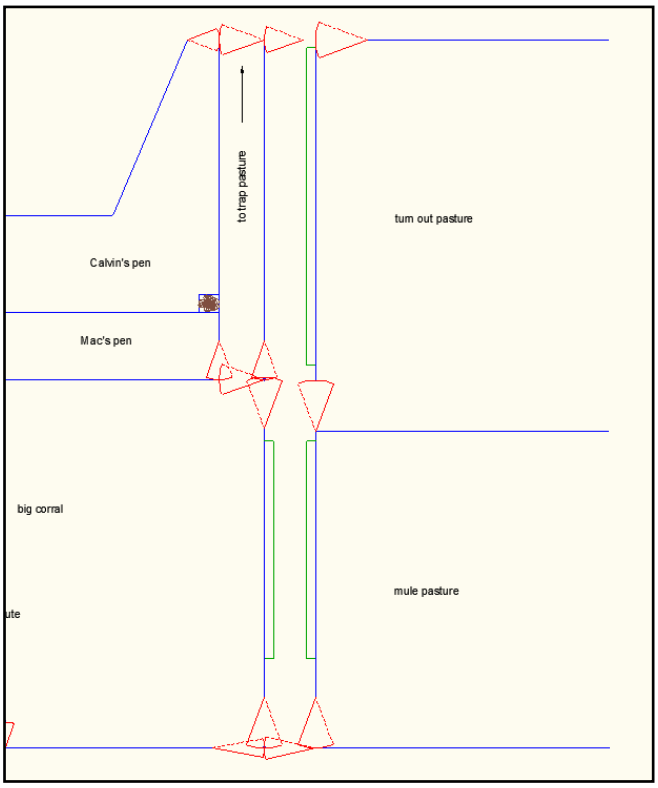

Figure 9 - Big Corral Design.

you can see in Figure 9 it seems as though the fence is on the wrong side of the feed bunks. This is not a true fence but rather a barrier so that the cattle cannot climb through the feed bunks. Another advantage to this is so when people are feeding the cattle they don't have to throw the feed over a fence but rather just set it in the bunks. By adding in the sixteen-foot gates at all ends of the bunkers the trucks and tractors can get in and out.

The gates are long enough that the truck alley can be shut off if cattle need to be run from the big corral to either of the paddocks. The addition of the bunkers not only allows trucks to get in and out easier but rather a healthier and cleaner place for the cattle to eat. So many times cattle ranchers simply throw the hay or feed on the ground for the cattle to eat. While this is common practice, there is much more chance for animals to catch diseases or eat things that are not good for digestion, especially in an area of high animal traffic.

Transport Pens

The purpose of the transport pens is for holding cattle that are only staying for a short time or can be used as holding pens while specific groups of cattle are being processed. With the new design there are three transport pens. Permanent feed bunkers have been added so cattle are not eating off of the ground. On the east side of the bunkers an overhang was placed so hay could be stored by people that are dropping off cattle for shipment and also to store small pieces of equipment out of the weather. The overhang is forty-feet long by eight-feet deep. By creating three different transport pens it allows people who have a small number of cattle to hold them overnight while keeping them separate from other ranches cattle. A water trough was added because before there was only one pen so the current water trough was sufficient. New water lines will be dug and installed. Only one water trough has to be added because the middle transport pen and bath tub pen can share a water trough. Three new gates are added to allow trucks but mostly tractors with scrapers to clean out pens. The gates are twelve-feet long. These gates are also wide enough that a water truck can get through to perform dust control on

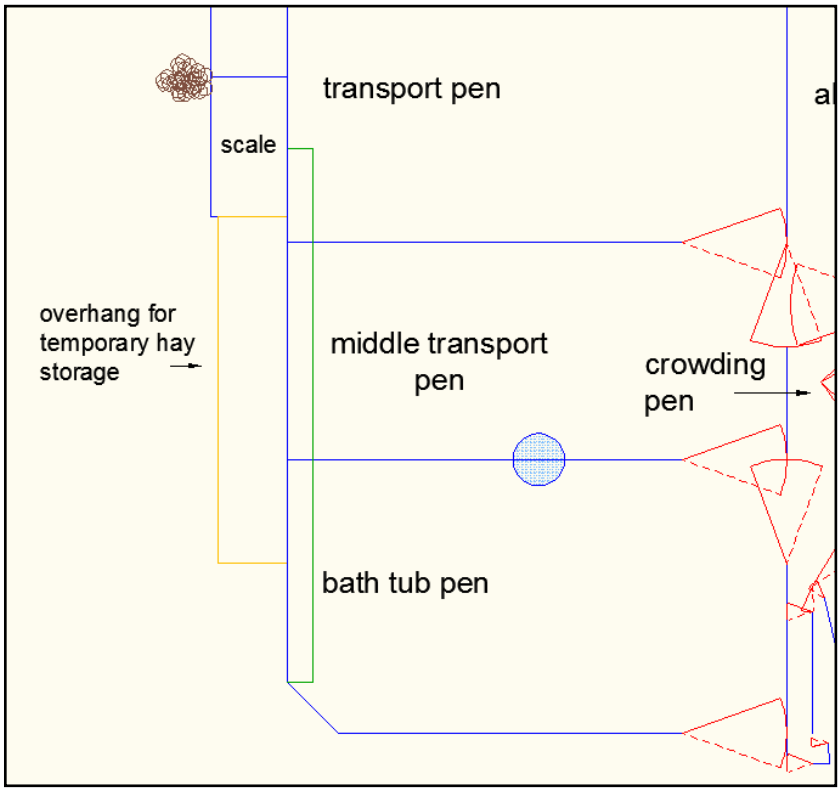

Figure 10 - Transport Pens Design.

the facility. The update can be seen in Figure 10 below. The scale that is in the design is an outdated wood unit. This scale will stay in place until funding comes in to upgrade the unit to a more accurate model.

Processing Area

The processing area is the hardest part to design due to the amount of tasks that are performed within it. A lot of the existing panels and gates were used with some slight modifications to allow for more calm and efficient movement of cattle. By adding the fourteen-foot gate in the crowding pen the cattle will have a wider area to move into while still funneling them down into the lead-up chute. This makes the cattle think that they are simply moving around in the pen while not feeling as forced when trying to go into the lead-up chute. A nice addition is the diversion gate that is built into the lead-up chute. When cattle need to go to the squeeze chute, the diversion gate, which is six- feet long will be blocking the calf table lead-up chute. When calves need to be branded,

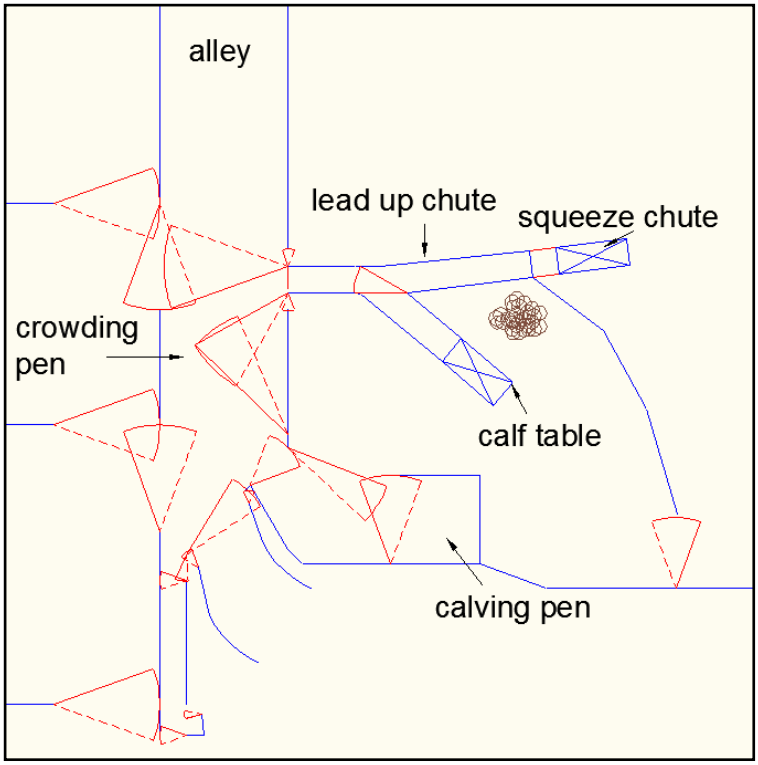

Figure 11 - Processing Area Design.

castrated, and vaccinated the gate will simply swing and lock into the other side thus blocking the path to the squeeze chute. Many companies manufacture diversion gates but the ranch has the materials and knowledge to build their own. In the old design there were two trees in the calf table pen but recent winds knocked the tree down which now allows more room in the pen. Another addition to the processing area is the calving pen. This will allow handlers to bring in a cow or heifer that is having calving trouble to place in the calving pen which also has a head gate. This pen puts less stress on the females because they are not forced to go down the lead-up chute to the squeeze where they might not fit. With the calving pen placed inside the same pen as the calf table, the female that

had calving trouble can be closely monitored without turning her out into the big corral. This pen can also be used as a holding pen for calves or even a small transport pen. The calf table is currently portable so after the calves have been worked it will be removed to allow for more room inside the pen. An eight-foot gate in the southeast end of the calf table pen makes it so if needed cattle can be turned out into the big corral instead of running them back through the crowding pen.

DISCUSSION

During the design process there were many alterations made as Mr. Tulloch reviewed the facility layout to assure it met his criteria. The final design layout presented in Appendix C was created from many prior drawings submitted to Mr. Tulloch for him to review. His revisions included additional gates in the transport pens, a water trough for the transport pens that was left out, and the placement of the fence to the feed bunkers within the big corral, mule and turn out pastures.

It is hoped that the new cattle handling facility will emulate the positive conditions of the existing system to allow for better cattle movement. The design was able to correct the limited number of transport pens and pens with feed bunks. Also the congestion in the processing area was cleared up so the flow of cattle is much better.

The design expanded the processing area and incorporated the use of a diversion gate so cattle can either go to the squeeze chute or the calf table. This is a more permanent set up and huge improvement for the ranch. All fences will be permanent allowing for safer operation for both the cattle and the handlers. The funnel feature that the gates create in the crowding pen make cattle feel less constricted and encourages movement into the lead-up chute.

The locations of all new gates in the new facility design were manipulated until the most efficient placement and swing patterns could be achieved. They will operate in conjunction with daily routines but are not limited in function and will work well for all operations in the facility.

As the project developed, some initial emphasis was placed on developing a design for a new scale and hydraulic squeeze chute. However, due to limited funding for the ranch, this portion of the design was eliminated because it would not be able to be installed.

This senior project only addressed the preliminary stages of the design. The author looks forward to working with Mr. Tulloch as the project continues to develop and be built.

RECOMMENDATIONS

The client was very satisfied with the design that was presented. Although he was happy there are some recommendations that can be made to alter to movement of the cattle through the system or improve upon the design.

Scale

With the design that was presented, the old scale is seen on the west side of the transport pens. Currently this scale does not function. It is recommended to remove or re-locate the wooden scale and install a more current and technologically advanced scale for ranch use. This new scale will allow the ranch to obtain more accurate weights when shipping cattle or weighing steers. Currently the handlers use estimation to achieve weights but with a new scale they can ensure weights for the trucks so they are of legal transport weights. The scale shown in Figure 12 is twelve-feet long and would perfectly replace the old one without having to make any severe modifications to the design or fencing. Scales like this can be costly so the scale might not be purchased immediately and will have to wait for future funding.

Figure 12 - Abilene 12' scale.

Hydraulic squeeze chute

Another recommendation that could be an option for the processing area is purchasing a new squeeze chute. Currently the ranch uses a Powder River squeeze chute that is manually operated. With this type of chute some handlers have trouble running the chute by themselves; therefore the need for more handlers is required. Only one person on the ranch can use the chute with no other help. This can be challenging because at times there is limited help. With a hydraulic squeeze chute there is only one person needed to operate

Figure 13 - Powder River Rancher hydraulic squeeze chute with pivot arm.

the levers as shown in Figure 13 below. The ranch did look into purchasing a chute like this but at the time the price was $6,500 for a show model which means a brand new model out of the factory would be much more. Funding for the ranch has been low seeing as the cattle industry was not doing so well in the past five years. The ranch could manage with the current squeeze chute but having a hydraulic chute would allow for higher productivity and less labor. Along with purchasing and installing a chute like the one on Figure 13, the ranch would have to have a source of power and a hydraulic reservoir. It could be done in the future if the ranch brought in more profits in the coming years.

REFERENCES

Abilene Scale Company: Livestock Scales: Customized Cattle Scales. Web. 02 June 2010. <http://abilenescale.com/Scales.aspx#12>.

"Animal behavior: Definition." Life Science Glossary. 29 Apr. 2009 <http://www.everythingbio.com/glos/definition.php?word=animal+behavior>.

“Cattle Handling and Working Facilities.” Ohioline. 19 May 2009 <http://ohioline.osu.edu/b906/index.html>.

“Cattle Handling Facilities: Planning, Components, and Layouts.” Cooperative Extension Service of the University of Kentucky. 02 June 2009 <http://www.ca.uky.edu/agc/pubs/aen/aen82/aen82.pdf>

“Corral and Working Facilities for Beef Cattle.” Oklahoma Cooperative Extension Service. 02 June 2009 < http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1998/F-1219web.pdf>.

Epps, Stephanie. "The Social Behavior of Beef Cattle." (2006).

Field, Thomas G. *Beef production and management decisions*. Upper Saddle River, N.J: Prentice Hall, 2003. Print.

Google Earth. Computer software. Vers. 2010. Web. 09 June 2010

.Grandin, Temple. Beef Cattle Handling and Facilities Design. 2nd ed. Fort Collins: Grandin Livestock Systems, 2000.

---. Humane Livestock Handling. North Adams: Storey, 2008.

---. “Laying Out Curved Cattle Handling Facilities.” National Cattlemen July 2008: 12-13

---. Livestock Handling and Transport. New York: Oxford, 1993.

---. Livestock Handling and Transportation. New York: Oxford UP, 2007.

---. Thinking in Pictures. New York: Vintage, 2006.

Johnston, Jack. "Pearson Inc. Equipment Catalog." E-mail interview. 29 Apr. 2009.

Lee, Ching. “Attention to detail characterizes animal scientist’s work.” Ag. Alert [Sacramento] 11 Mar. 2009: 22-23.

Pearson’s Inc. Pearson Livestock Equipment. Brochure. Thedford: Author, 2008.

Phillips, C.J.C.. Principles of Cattle Production. New York: Oxford UP, 2001.

Powder River. Powder River Livestock Handling Equipment. Brochure. Provo: Author, 2008.

Tulloch, B 2009. Personal Communication.

"Yahoo Maps." *Yahoo! Maps, Driving Directions, and Traffic*. Web. 09 June 2010. <http://www.maps.yahoo.com>.

APPENDIX A

HOW PROJECT MEETS REQUIREMENTS FOR THE ASM MAJOR

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ASM PROJECT REQUIREMENTS

The ASM senior project must include a problem solving experience that incorporates the application of technology and the organizational skills of business and management, and quantitative, analytical problem solving. This project addresses these issues as follows.

Application of Agricultural Technology. The project will involve the application of problem solving, design procedures, material handling, mechanical systems, and fabrication technologies.

Application of Business and/ or Management Skills. The project will involve business and management skills in machinery management, livestock management, productivity analysis, and labor considerations.

Quantitative, Analytical Problem Solving. ; Quantitative problem solving will include the design of a more adequate handling facility.

Capstone Project Experience

The ASM senior project must incorporate knowledge and skills acquired in earlier coursework (Major, Support, and/ or GE courses). This project incorporates knowledge/ skills from these key courses.

- AGB 321 Farm Records
- AGB 322 Principles of Agribusiness Management
- ASCI 112 Principles of Animal Science
- ASCI 221 Introduction to Beef Production
- ASCI 311 Advanced Beef Cattle System Management
- BRAE 133 Engineering Design Graphics
- BRAE 151 CAD for Agricultural Engineering
- BRAE 203 Agricultural Systems Analysis
- BRAE 237 Engineering Surveying
- BRAE 321 Agricultural Safety
- BRAE 342 Agricultural Materials
- BRAE 418 Agricultural Systems Management I
- BRAE 419 Agricultural Systems Management II
- ENGL 148 Reasoning, Argumentation, and Professional Writing
- SS 121 Introductory Soil Science

ASM Approach

Agricultural Systems Management involves the development for solutions to technological, business or management problems associated with agricultural or related industries. A systems approach, interdisciplinary experience, and agricultural training in specialized areas are common features of this type of problem solving. This project addresses these issues as follows.

Systems Approach. The project involves the combination of many functions (safety guards, cattle safety, operator safety, cattle handling), and the combination of design and mechanical systems to provide an improved cattle handling facility for Tulloch Ranches.

Interdisciplinary Features. The project includes aspects of mechanical systems and design, agricultural safety, and livestock production systems.

Specialized Agricultural Knowledge. The project applies specialized knowledge in the areas of mechanical and fabrication systems, agricultural safety, and cattle behavior.

APPENDIX B

MAPS AND PHOTOS

MAPS

House and cattle handling facility

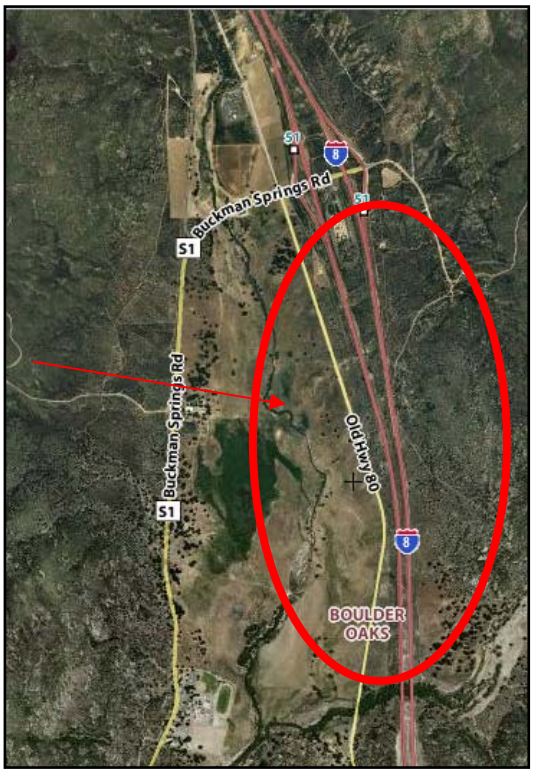


Figure 14 – Ranch photograph

Hay barn

Big corral

Figure 15 – Map of cattle handling facility

FACILITY PHOTOGRAPHS

Figure 16 – View from Jerry's office pen

Figure 17 – Transport Pen

Figure 18 – View to the east of transport pen

Figure 19 – Crowding pen

Figure 20 – Crowding pen and loading chutes

Figure 21 – Loading chutes

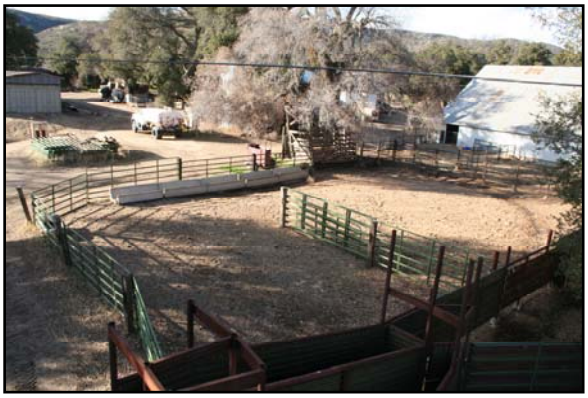


Figure 22 – View from east looking west to transport pen

Figure 23 – Location for calving pen and calf table

Figure 24 – East side of big corral and west side of mule pasture

Figure 25 – Big corral

Figure 26 – Corner of Mac's pen

Figure 27 – Gates in corner of big corral and mule pasture

Figure 28 – North side of alley

Figure 29 – North view of transport pen

Figure 30 – Alley and transport pen

Figure 31 - Scale

Figure 32- Lead-up and squeeze chute

Figure 33 – Closer view of lead-up and squeeze chute

APPENDIX C

DRAWINGS

DRAWINGS

OLD SYSTEM

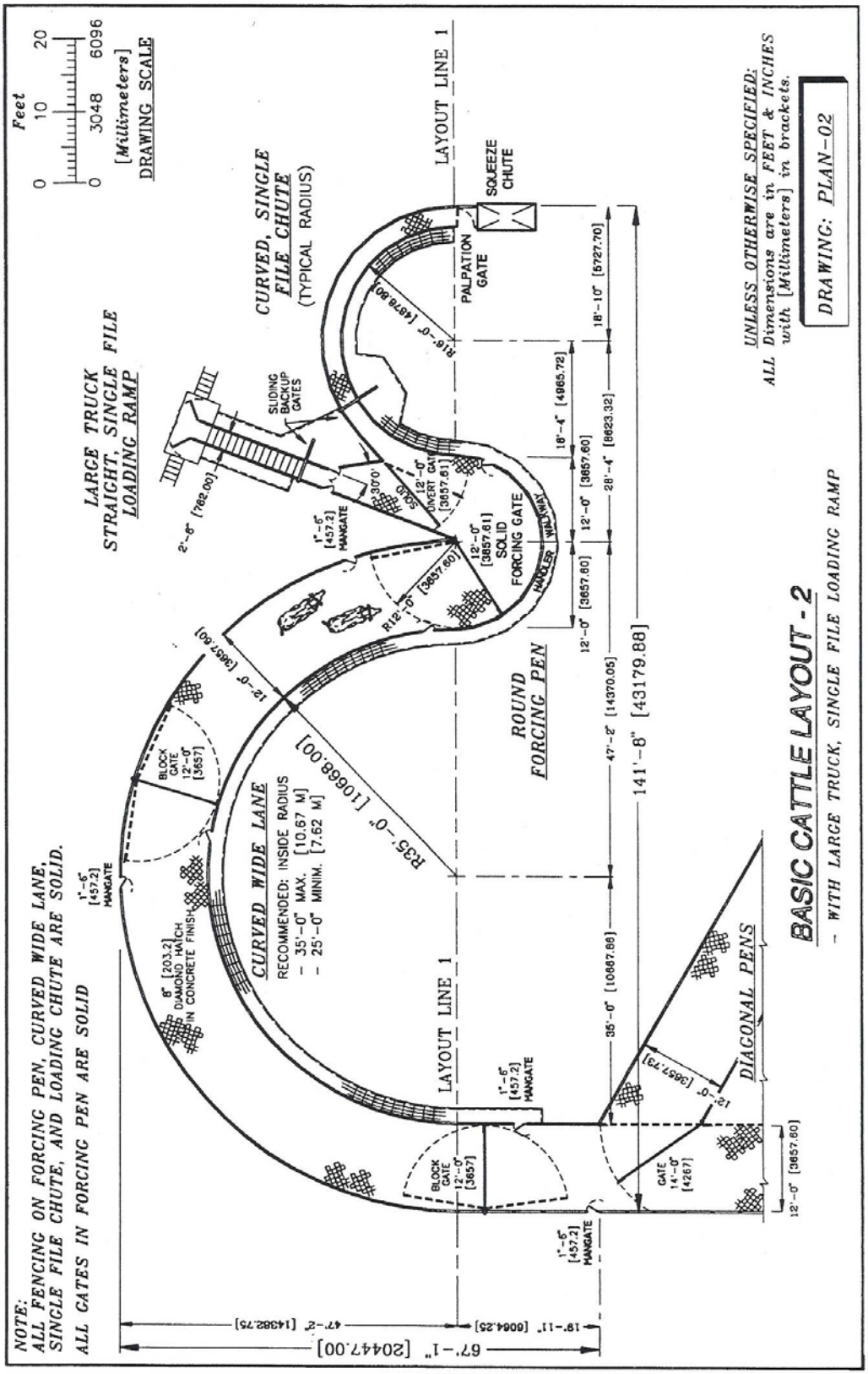
NEW SYSTEM

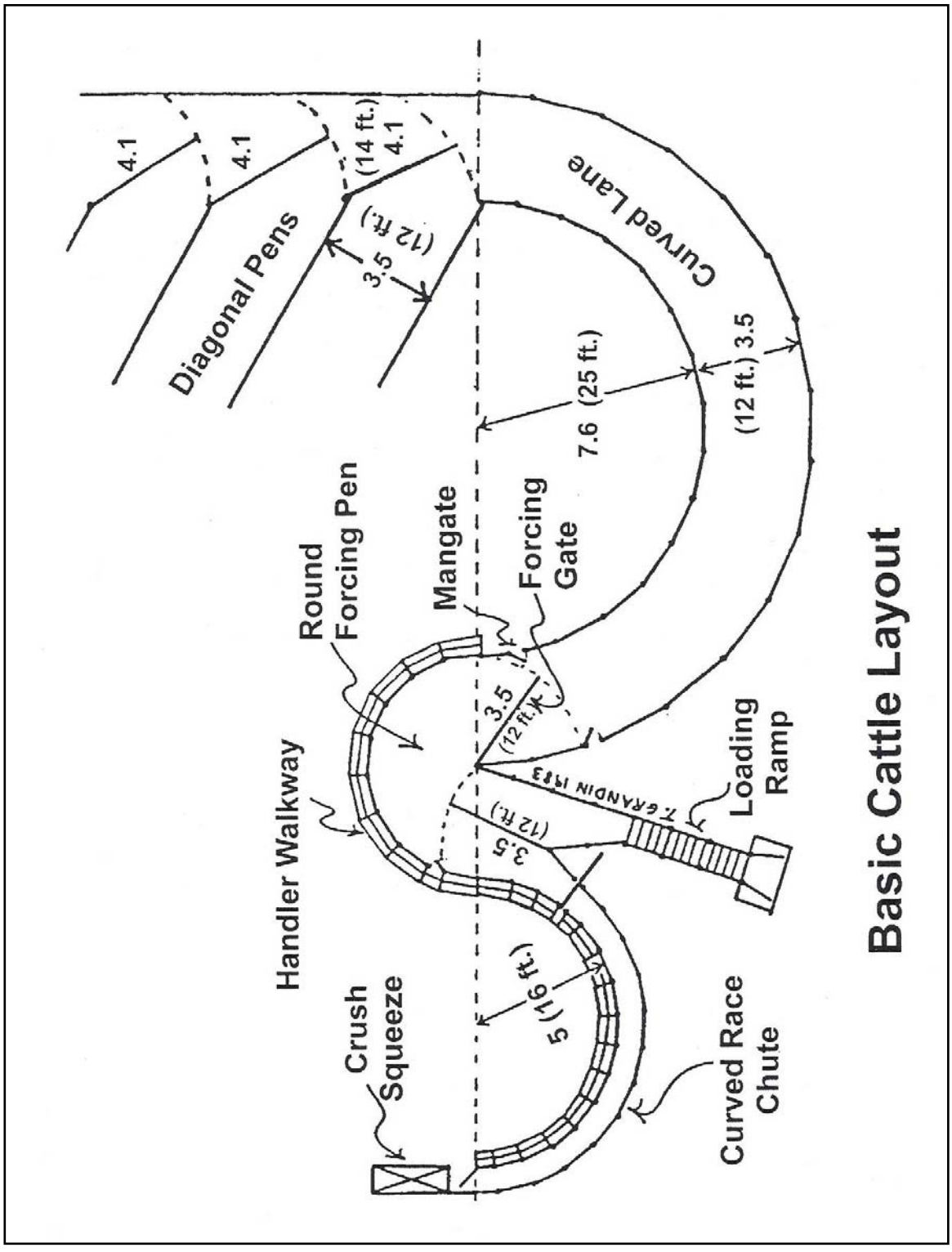
NEW SYSTEM WITH DIMENSIONS

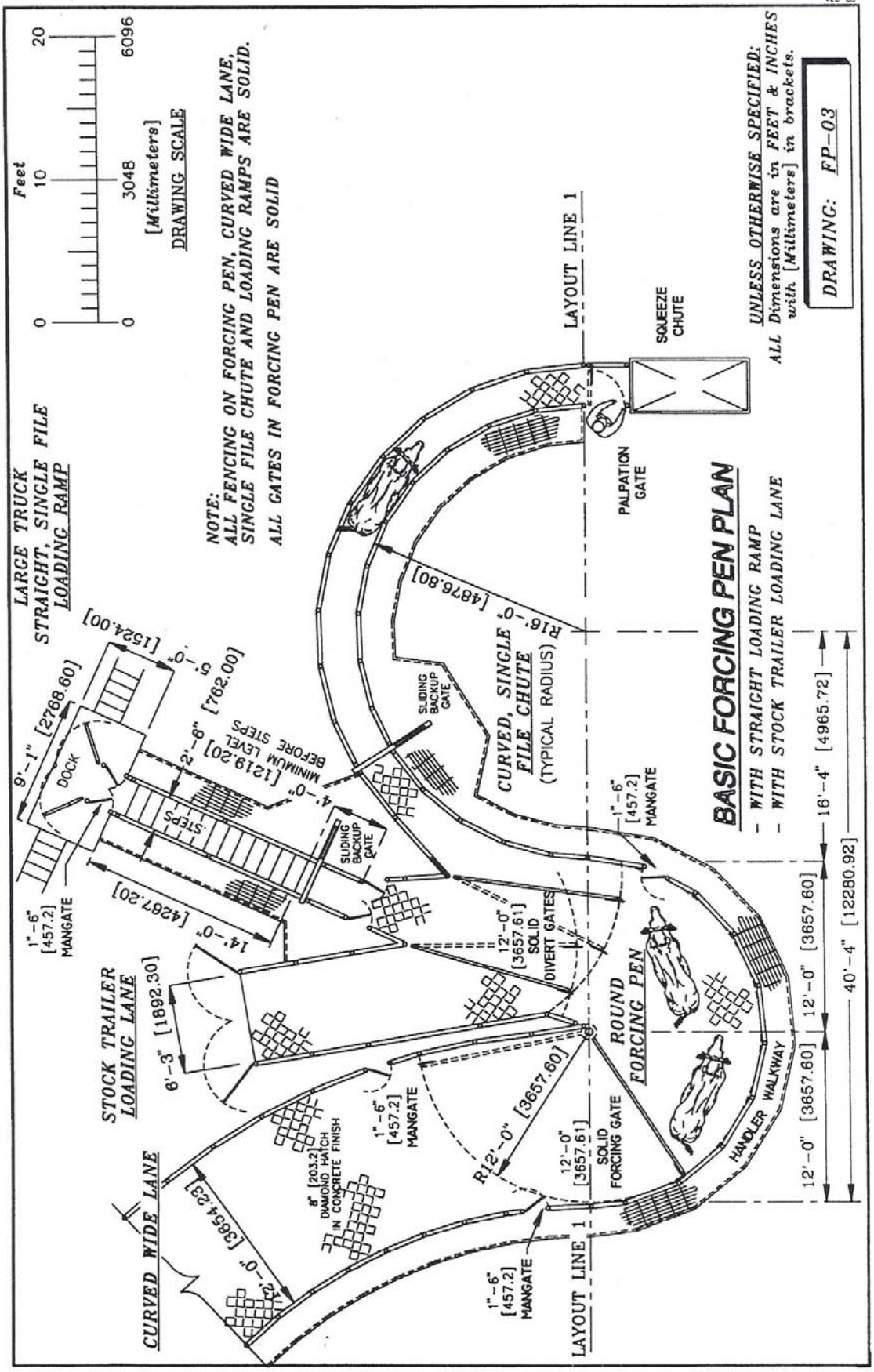
APPENDIX D

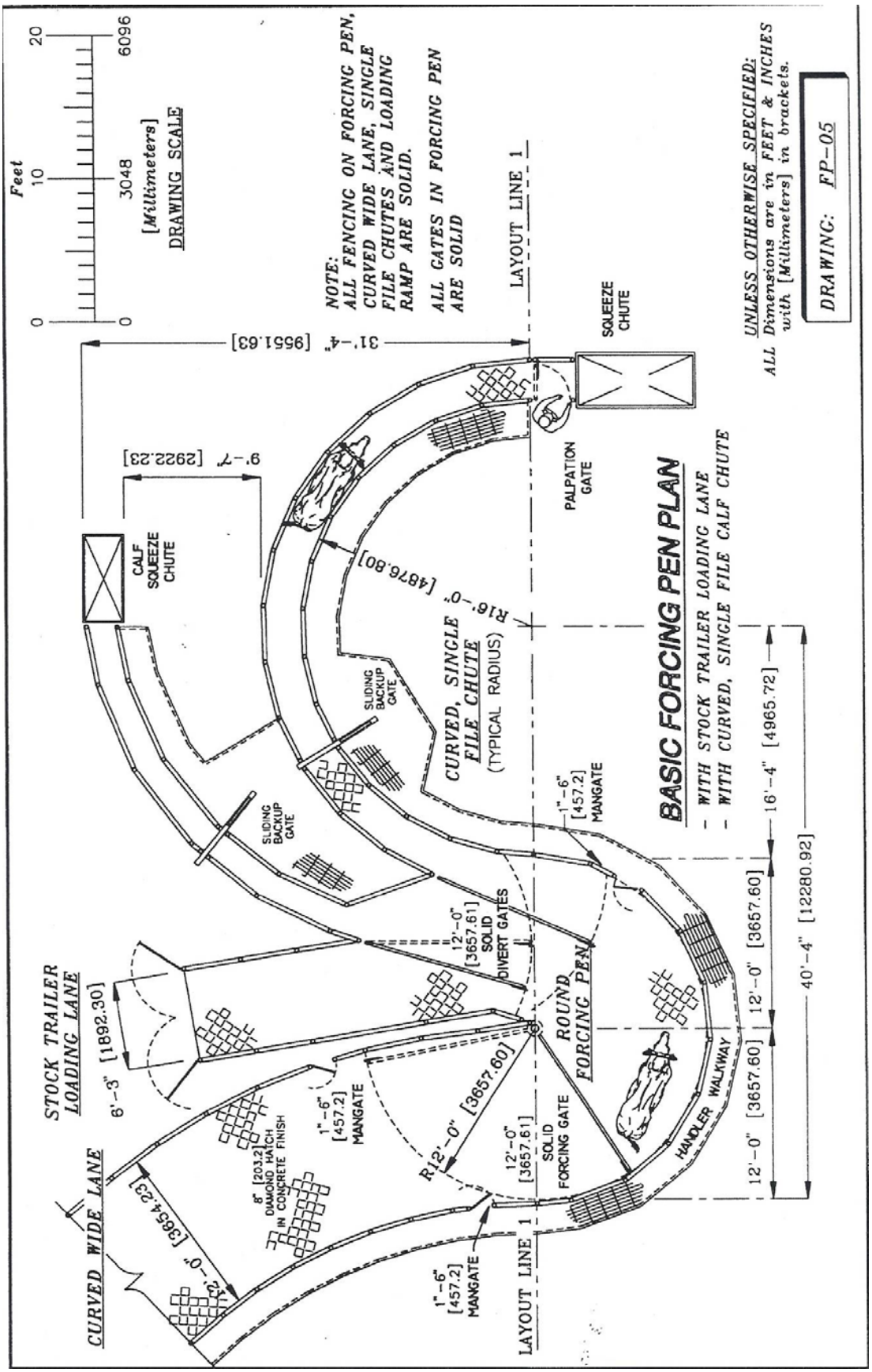
REFERENCE MATERIAL

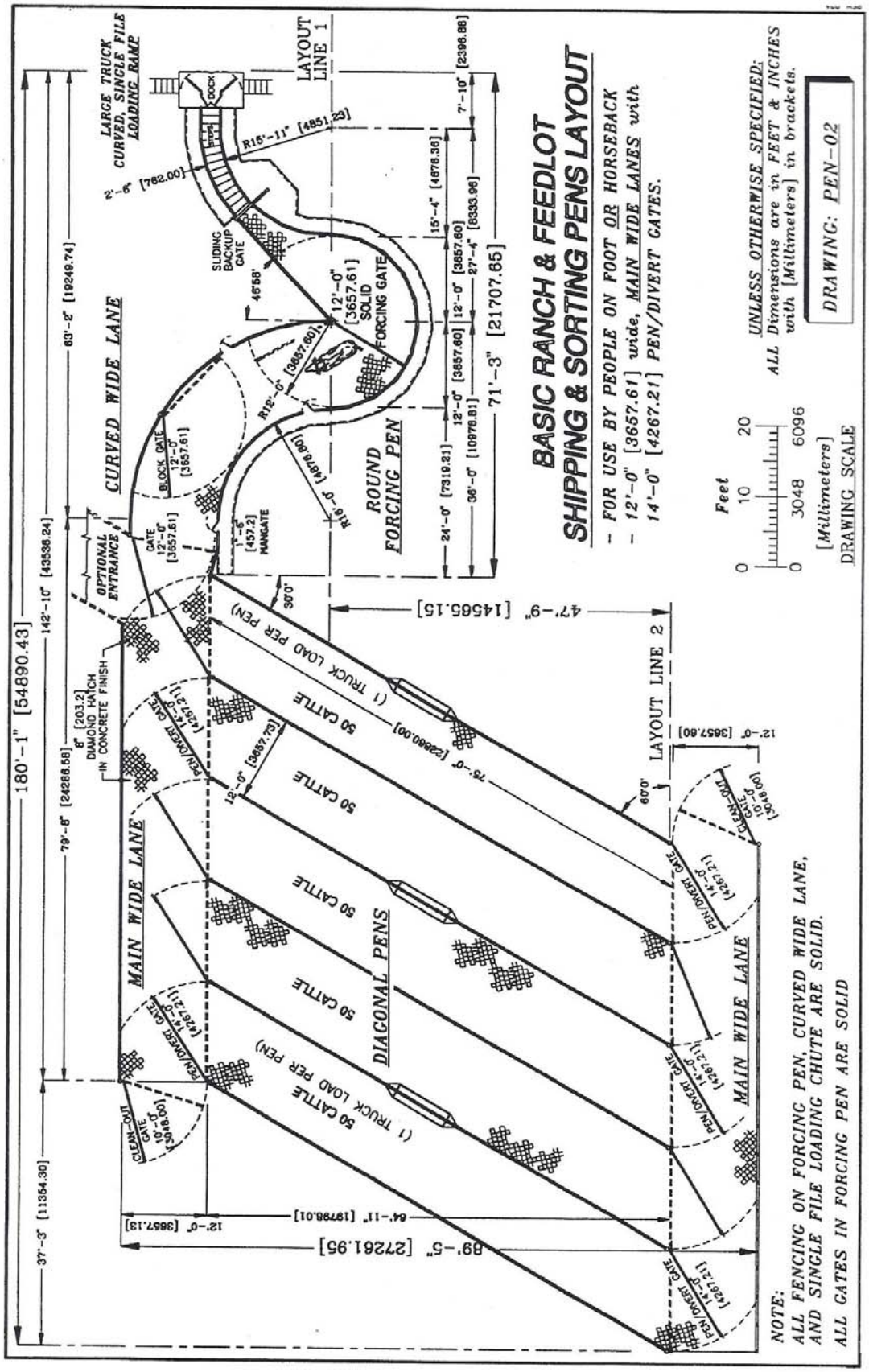
REFERENCE MATERIALS



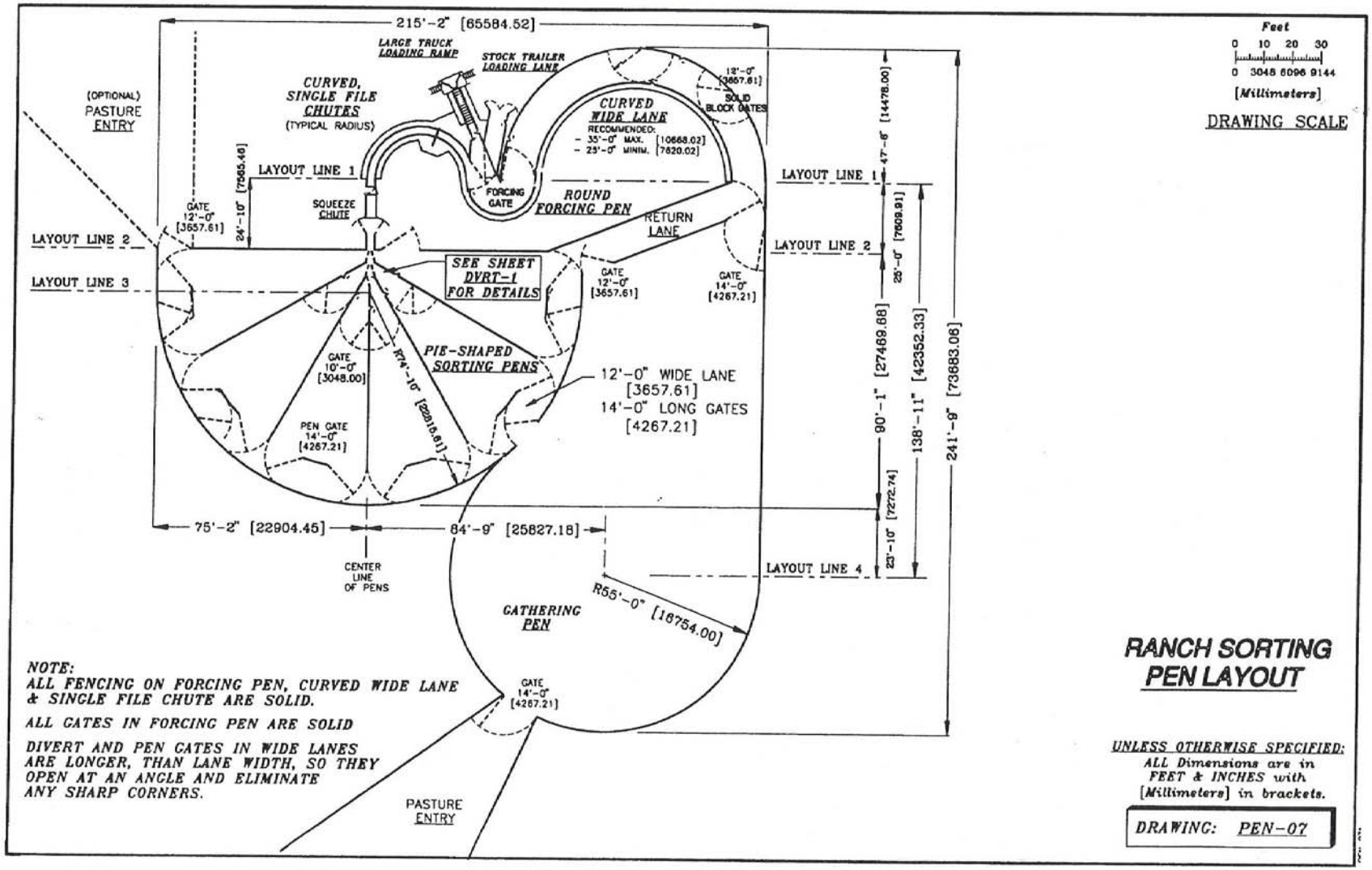

Basic Cattle Layout
Handler Walkway
Round Forcing Pen
Mangate
Forcing Gate
Curved Lane
Diagonal Pens
Crush Squeeze
Curved Race Chute
Loading Ramp
4.1
4.1
(14 ft.)
4.1
(12 ft.)
3.5
7.6 (25 ft.)
(12 ft.) 3.5
3.5
(12 ft.)
3.5
(12 ft.)
5 (16 ft.)


BASIC FORCING PEN PLAN
- WITH STRAIGHT LOADING RAMP
- WITH STOCK TRAILER LOADING LANE
UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.
DRAWING: FP-03
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE, SINGLE FILE CHUTE AND LOADING RAMPS ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID
DRAWING SCALE
Feet
Millimeters
LARGE TRUCK STRAIGHT, SINGLE FILE LOADING RAMP
CURVED WIDE LANE
STOCK TRAILER LOADING LANE
CURVED, SINGLE FILE CHUTE
(TYPICAL RADIUS)
ROUND FORCING PEN
LAYOUT LINE 1
SQUEEZE CHUTE
PALPATION GATE
SLIDING BACKUP GATE
SOLID FORCING GATE
DIVERT GATES
HANDLER WALKWAY
DOCK
STEPS
MINIMUM LEVEL BEFORE STEPS
8" [203.2] DIAMOND HATCH IN CONCRETE FINISH
1'-6" [457.2] MANGATE
12'-0" [3657.61] SOLID
R16'-0" [4876.80]
R12'-0" [3657.60]
16'-4" [4965.72]
40'-4" [12280.92]


Feet
0
10
20
3048
6096
[Millimeters]
DRAWING SCALE
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE, SINGLE FILE CHUTES AND LOADING RAMP ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID
LAYOUT LINE 1
31'-4" [9551.63]
9'-7" [2922.23]
CALF SQUEEZE CHUTE
SQUEEZE CHUTE
PALPATION GATE
R16'-0" [4876.80]
SLIDING BACKUP GATE
CURVED, SINGLE FILE CHUTE
(TYPICAL RADIUS)
1"-6" [457.2] MANGATE
BASIC FORCING PEN PLAN
- WITH STOCK TRAILER LOADING LANE
- WITH CURVED, SINGLE FILE CALF CHUTE
UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.
DRAWING: FP-05
STOCK TRAILER LOADING LANE
6'-3" [1892.30]
12'-0" [3657.61] SOLID DIVERT GATES
ROUND FORCING PEN
CURVED WIDE LANE
12'-0" [3654.23]
8" [203.2] DIAMOND HATCH IN CONCRETE FINISH
1"-6" [457.2] MANGATE
R12'-0" [3657.60]
12'-0" [3657.61] SOLID FORCING GATE
HANDLER WALKWAY
LAYOUT LINE 1
1"-6" [457.2] MANGATE
12'-0" [3657.60]
12'-0" [3657.60]
16'-4" [4965.72]
40'-4" [12280.92]

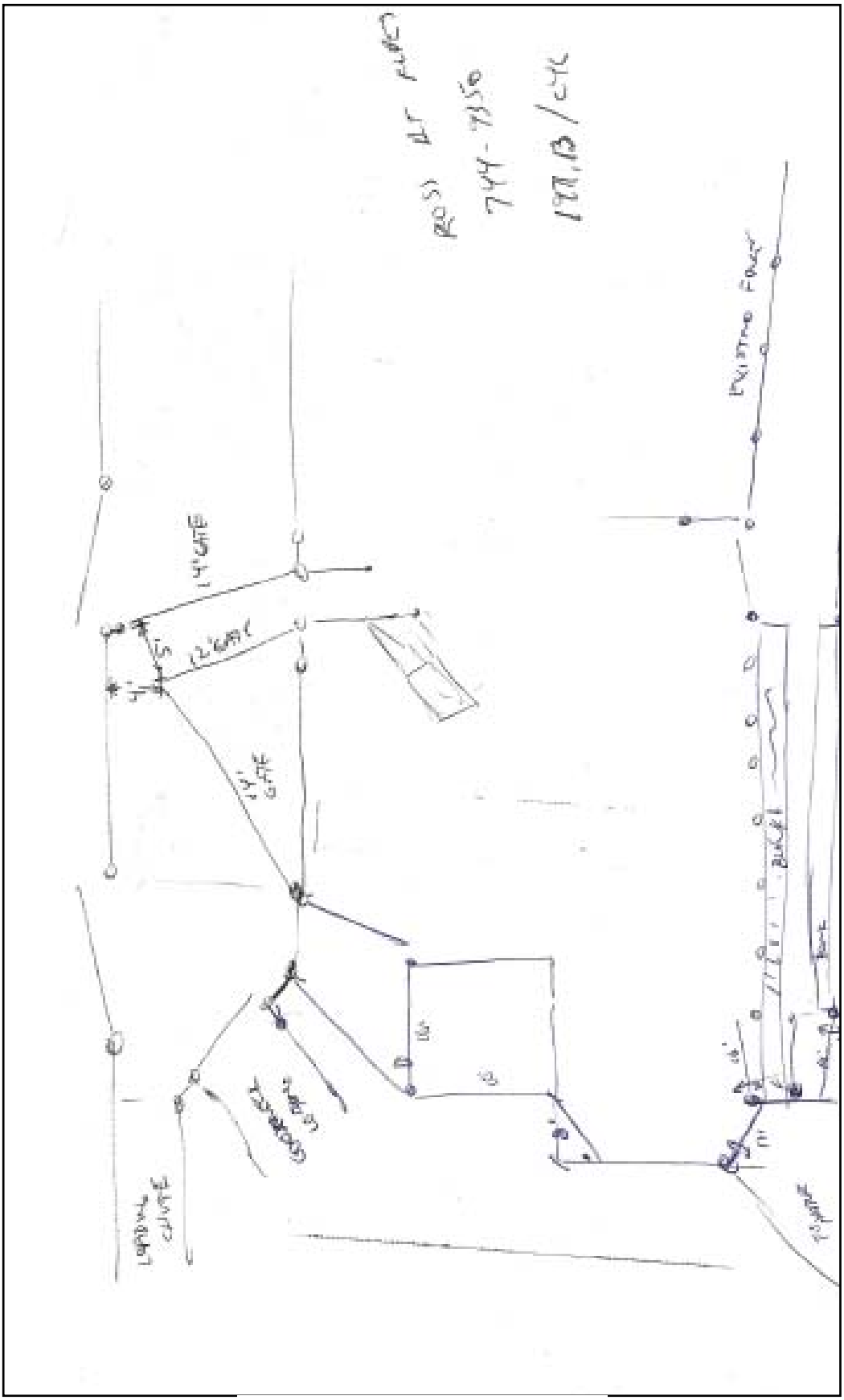


NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE, AND SINGLE FILE LOADING CHUTE ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID

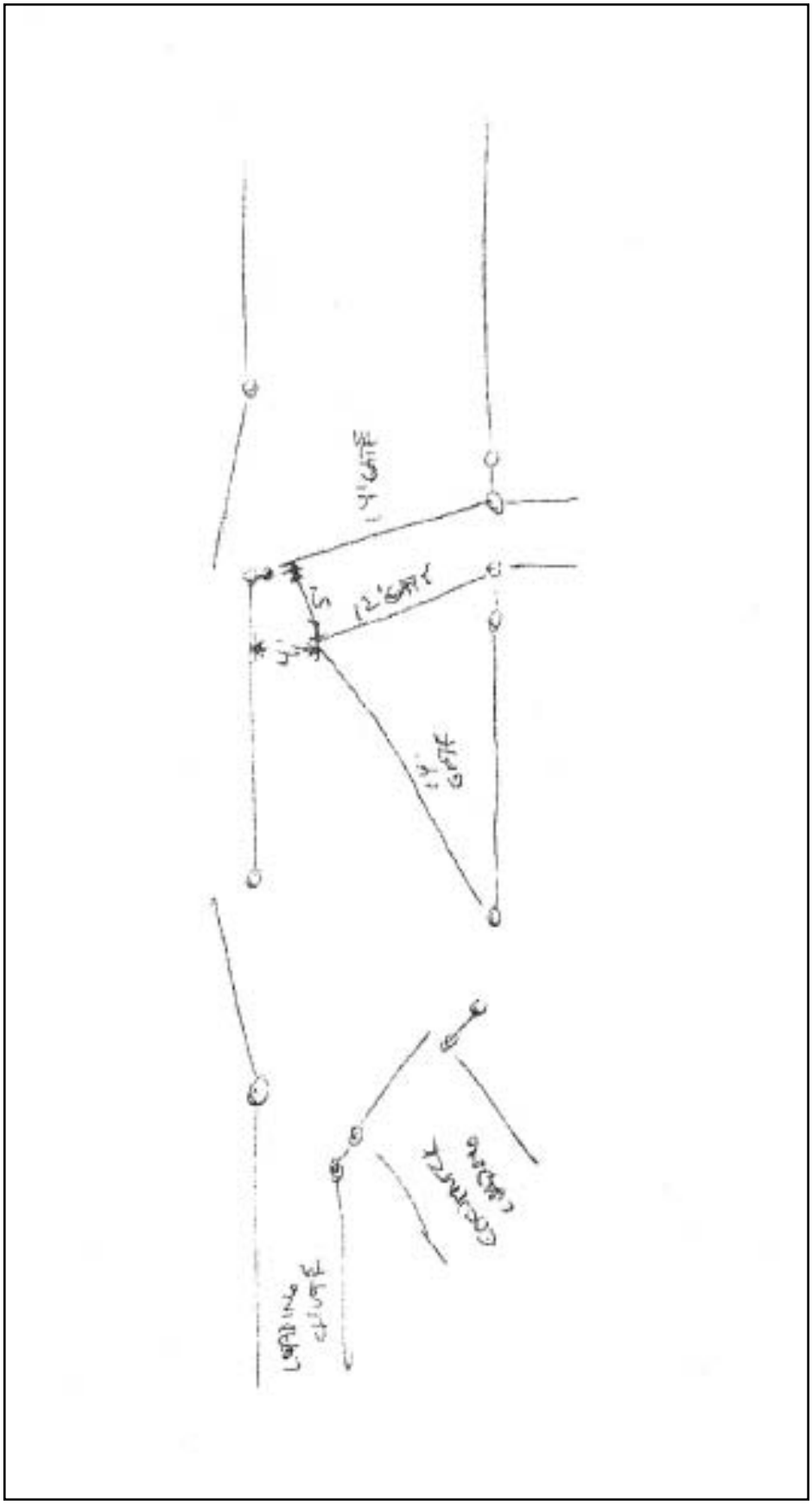

215'-2" [65584.52]
LARGE TRUCK LOADING RAMP
STOCK TRAILER LOADING LANE
(OPTIONAL) PASTURE ENTRY
CURVED, SINGLE FILE CHUTES (TYPICAL RADIUS)
CURVED WIDE LANE
RECOMMENDED:
- 35'-0" MAX. [10668.02]
- 25'-0" MINIM. [7620.02]
12'-0" [3657.61]
SOLID BLOCK GATES
LAYOUT LINE 1
24'-10" [7565.46]
GATE 12'-0" [3657.61]
SQUEEZE CHUTE
FORCING GATE
ROUND FORCING PEN
RETURN LANE
LAYOUT LINE 2
LAYOUT LINE 3
SEE SHEET DVRT-1 FOR DETAILS
GATE 12'-0" [3657.61]
GATE 14'-0" [4267.21]
PIE-SHAPED SORTING PENS
GATE 10'-0" [3048.00]
R74'-10" [22815.61]
PEN GATE 14'-0" [4267.21]
12'-0" WIDE LANE [3657.61]
14'-0" LONG GATES [4267.21]
47'-6" [14478.00]
25'-0" [7609.91]
90'-1" [27469.68]
138'-11" [42352.33]
241'-9" [73683.08]
23'-10" [7272.74]
75'-2" [22904.45]
84'-9" [25827.18]
CENTER LINE OF PENS
LAYOUT LINE 4
R55'-0" [16754.00]
GATHERING PEN
GATE 14'-0" [4267.21]
PASTURE ENTRY
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE & SINGLE FILE CHUTE ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID
DIVERT AND PEN GATES IN WIDE LANES ARE LONGER, THAN LANE WIDTH, SO THEY OPEN AT AN ANGLE AND ELIMINATE ANY SHARP CORNERS.
Feet
0 10 20 30
0 3048 6096 9144
[Millimeters]
DRAWING SCALE
RANCH SORTING PEN LAYOUT
UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.
DRAWING: PEN-07

Design drawing #1

Design drawing #2



Design drawing #3



Design drawing #4